International Journal of Engineering Research (ISSN : 2319-6890)
Volume No.2, Issue No3, pp : 201-203 01 July 2013

Feasibility Study of Moringa Oleifera as a Natural Coagulant for the Treatment of Dairy Wastewater

Pallavi N. [1], Dr. S. Mahesh [2]

[1]Assistant Professor, VidhyaVardhaka College of Engineering, Mysore
[2]Associate Professor, Sri Jaya Chamarajendra College of Engineering, Mysore
Email : anupllavi2@gmail.com

Abstract :
India is a country of villages with animal husbandry as one of the most important occupations of the rural population. The dairy industry involves processing raw milk into products such as consumer milk, butter, cheese, yogurt, condensed milk, dried milk (milk powder), and ice cream, using processes such as chilling, pasteurization, and homogenization. Dairy effluents contain dissolved sugars and proteins, fats, and possibly residues of additives. The current technology for treating dairy wastewaters typically consists of biological aerobic and anaerobic digestion or facultative digestion. In the present study, a natural coagulant named Moringa Oleifera, was used to treat raw dairy wastewater. The Optimum MO dosage was found for 425, 212 and 150µm to be 300mgL-1, 500mgL-1 and 500mgL-1 respectively. Optimum pH of dairy wastewater to treat by Moringa Oleifera is 7.212µm particle size Moringa Oleifera reduced COD, total solids and oil & grease to 800, 884 and 94.4mgL-1 from its initial value of 2240, 1920 and 636.8mgL-1 respectively when experiments were run under optimum condition.

Keywords: Natural Coagulant, Moringea Oleifera, Dairy wastewater

Introduction

Today, India is the largest milk producing country in the world. Milk and milk products is rated as one of the most promising sectors which deserves appreciation in a big way. Almost every city regardless of its location has one or more plants which process raw milk to produce products. The dairy industry involves processing raw milk into products such as consumer milk, butter, cheese, yogurt, condensed milk, dried milk (milk powder), and ice cream, using processes such as chilling, pasteurization, and homogenization. Typical by-products include buttermilk, whey, and their derivatives. Unit operations that generate wastewater are 'washing' and 'disinfection' of equipment (tanks, centrifuges, pasteurizers, homogenizers, pipes, pails, etc.), loss of packages containing milk, and loss during internal transportation. Depending on the type and capacity of the industry, raw sewage generated can reach high values of COD Biological treatment systems need proper maintenance and monitoring as the processes solely rely on microorganisms to break down the pollutants. The microorganisms are very sensitive to the changes in the environment and thus great care has to be taken to ensure that a conducive environment is maintained for the microorganisms to thrive in. It requires skilful attention, commitment and long retention time. Besides, it also generates a vast amount of biogas. This biogas contains methane, carbon dioxide and trace amounts of hydrogen sulphide. Some of these gases are corrosive and odorous. The treated water produced also cannot be recycled back to the plant. Conventional coagulants in waste water treatment are alum ($Al_2(SO4)_3 \cdot 14H_2O$), ferric chloride ($FeCl_3 \cdot 6H_2O$), sodium aluminate, aluminium chloride and ferric sulphate. Present studies have pointed out several serious drawbacks of using aluminium salts, such as the Alzheimer's disease. Aluminium has also been indicated to be a causative agent in neurological disease like 'per-senile dementia'. There is also the problem of the possible reaction of alum with the natural alkalinity present in the water leading to a reduction of pH. Environmental friendly coagulants would present a viable alternative for the treatment of wastewater.

Materials & Methodology

Moringa Oleeifera

Moringa Oleifera seed solutions may be prepared from either seed kernels or the solid residue (pressscake) obtained following the extraction of seed oil. The dried seed wings and seed coat were removed manually and good quality seed kernel was crushed to powder using domestic blender. Powdered Moringa Oleifera was sieved through selected sieve sizes. Four sieve sizes were selected i.e. 1.00mm, 425, 212 and 150µm.

Dairy Wastewater

The dairy wastewater was obtained directly from MYMUL, Mysore in Siddhartha layout using grab sampling method. The wastewater so procured was deep freezed and utilized as and when required for analysis and treatment.

Experimental Procedure

The coagulation experiments were carried out at ambient temperature in batch mode. Batch coagulation

experiments was carried out at an a agitation speed of 130rpm for 1min, slow mixing of 30- 35rpm for 15min and a settling time of 30 min. Four sieve sizes of powdered *Moringa Oleifera* were used 1.00mm, 425, 212 and 150µm in the experiment. Experiments were carried out for varying *Moringa Oleifera* dosage (150, 300, 500 and 1000mgL^{-1}), varying pH (3, 5, 7 and 9 pH), In each run turbidity and COD were measured using Standard procedures.

Results and Discussion

Coagulation studies at varying Dosage

To determine the optimum *Moringa Oleifera*, a series of experiments were carried out at varying *Moringa Oleifera* dose from 150, 300, 500 and 1000mgL^{-1} for particle sizes of 425, 212 and 150µm respectively. Experiment was carried out at an agitation speed of 130rpm for 1min following a slow mixing speed of 30 – 40 rpm for 15minutes and allowing a settling time of 30 min.

Turbidity values as a function of *Moringa Oleifera* dosage

Varying dosage of *Moringa Oleifera* in the removal of turbidity from dairy wastewater is shown as shown in Fig.1.a. As shown in the Fig., the turbidity decreases up to a point of *Moringa Oleifera* dosage and then it increases slightly. This is due to the fact that the *Moringa Oleifera* after the optimum dosage adds to the turbidity of wastewater. It was found that optimum *Moringa Oleifera* dosage of 425µm particle size is 300mgL^{-1} and for 150µm and 212µm particle size is 500mgL^{-1}.

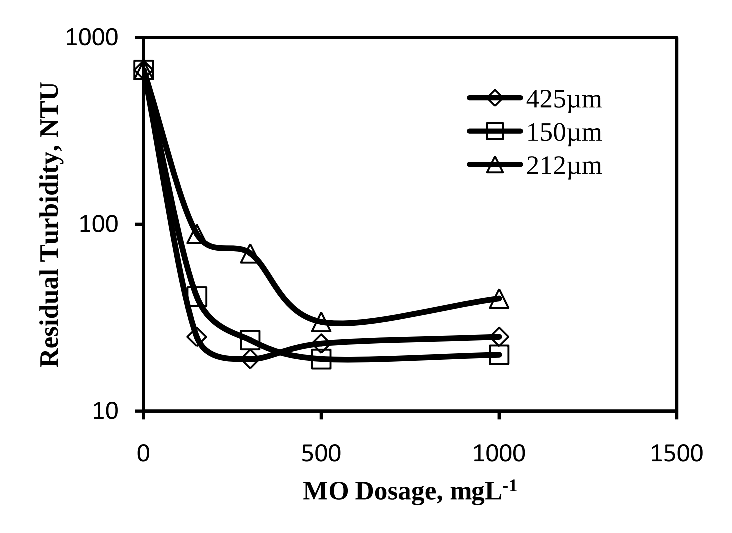


Fig.1.a. Turbidity values as a function of MO dosage.

COD values as a function of *Moringa Oleifera* dosage

The varying dosage of *Moringa Oleifera* in the removal of COD from a dairy industry wastewater is shown as shown in Fig.1.b. As shown in the Fig, the COD decreases gradually at a point of coagulant dosage and then increases slightly. COD was drastically reduced from 1440 to 640 and 800mgL^{-1} for 425µm, 15µm and 212µm particle size indicating a removal efficiency of 55.6% and 44.4% respectively.

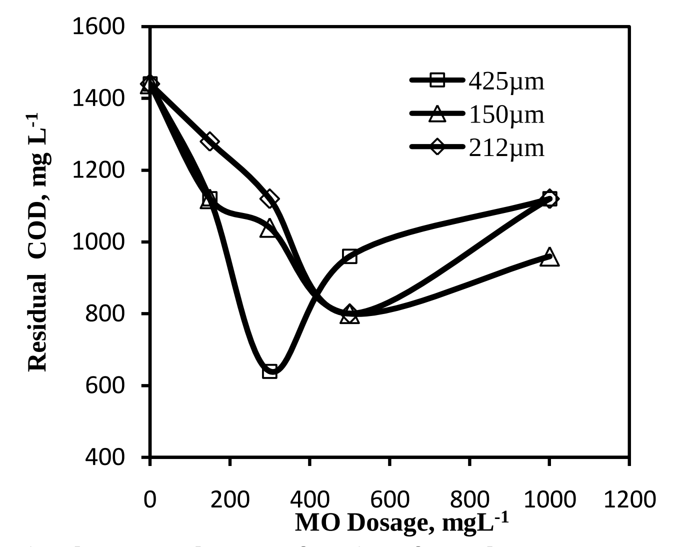


Fig.1.b. COD values as a function of MO dosage.

Coagulation studies at varying pH

MO pods contain cellulose, hemicellulose, lignin, and crude fiber. Its matrix network contains carboxylic, fiber carbonaceous, and amino functional groups. These functional groups may be dissociated at different pH values and consequently take part in the adsorption process. Therefore, pH may influence the adsorption of components onto MO The pH of the dairy wastewater was varied i.e. pH 3, 5, 7 and 9 to determine the optimum pH for maximum turbidity, COD and solids removal.

Turbidity values as a function of pH

Removal of turbidity at varying pH of dairy wastewater is shown in the Fig.2.a. As shown in Fig. maximum turbidity removal was observed at neutral range i.e. 7 i.e. 90, 93.5 and 96.8% for 425, 150 and 212µm particle sizes of *Moringa Oleifera*.

COD values as a function of pH

COD removal for varying pH of dairy wastewater is shown in Fig.2.b. As shown in the Fig. There is no sufficient reduction in COD when the wastewater pH is acidic. For 425µm particle size the optimum pH is found to be 7 – 9 with a removal efficiency of 55.5%. For 150 and 212µm particle size optimum pH is 7 with a removal efficiency of 44.4%.

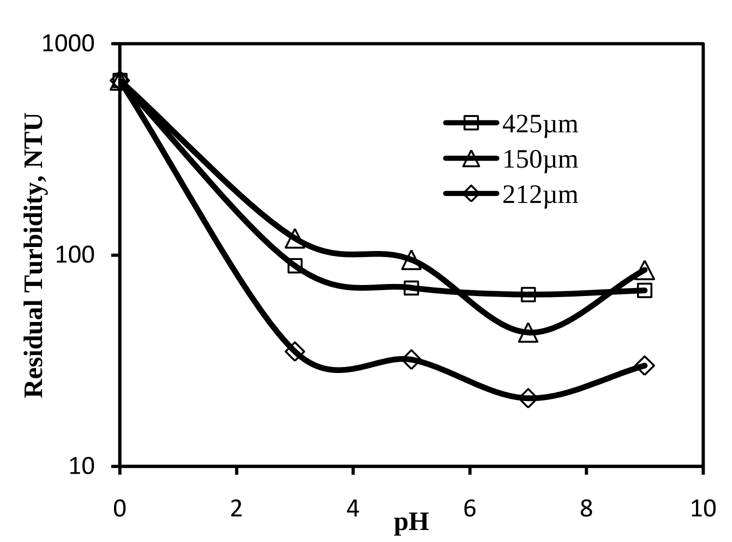


Fig. 2.a Turbidity values as a function of pH.

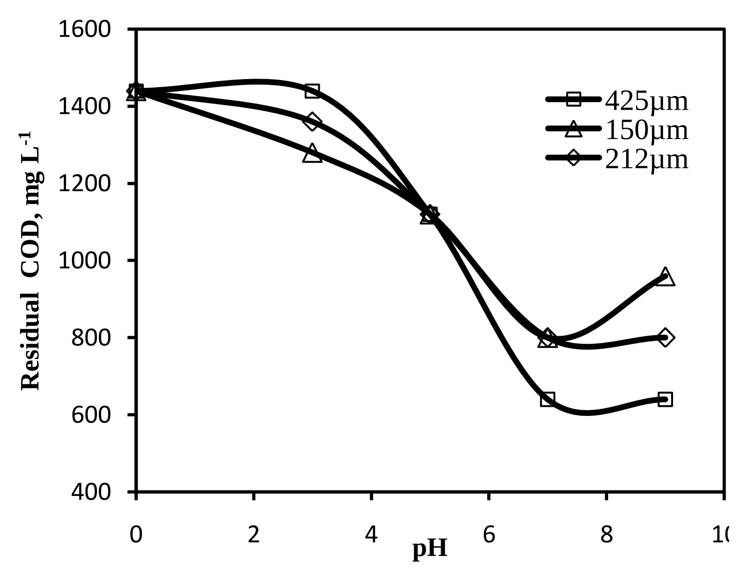


Fig.2.b COD Values as a function of pH.

Conclusion

Treatability of dairy wastewater was carried out using naturally available *Moringa Oleifera* as a coagulant. Powdered *Moringa Oleifera* was sieved and selected particle size (425, 150 and 212µ**m)** used in the study. The optimum dosage for 425, 150 and 212µm was found to be 300and 500mgL^{-1} respectively.

212µm particle size was most effective among other two in the reduction of COD. COD was reduced from 2240mgL^{-1} to 800, 960 and 1120mgL^{-1} by 212, 425 and 150µm particle size *Moringa Oleifera* respectively under the optimum condition of agitation speed of 150rpm for 3min, slow mixing of 30 – 40rpm for 15minutes and a settling time of 45min. Turbidity was reduced from 230NTU to 32, 26 and 42NTU by 212, 425 and 150µm particle size *Moringa Oleifera* respectively.

References

i. *American Public Health Association(APHA), American water works association and water pollution control federation, Standard Methods for examination of water and wastewater, 15th edition, Washington DC, USA,* ***2006.***

ii. *Akhtar. M, Moosa H. S, Bhanger. M. I, & Iqbal. S. Sorption potential of Moringa oleifera pods for the removal of organic pollutants from aqueous solutions. Journal of Hazardous Material, 141, 3, 546–556,* ***2007****.*

iii. *Amagloh.F.K and Benang.A. Effectiveness of Moringa Oleifera seed as coagulant for water purification. African Journal of agricultural research, 4, 1, 119-123,* ***February 2009.***

iv. *Babu.R and Chaudhuri. Home water treatment by direct filtration with natural coagulant. Journal of Water and Health, 3, 27 -30,* ***2005.***

v. *Barbty.J. Coagulation and flocculation in water and wastewater. IWA publishers, 32 – 60, 152,* ***2006.***

vi. *Beddow.V. Coagulation and flocculation in water and wastewater. IWA publishers,* ***2010.***

vii. *Bhatia. S, Othman. Z and Ahmad. A.L. Pretreatment of palm oil mill effluent (POME) using Moringa Oleifera seeds as natural coagulant. Journal of Hazardous materials, 145, 120 – 126,* ***2007.***

viii. *Bhatia. S, Othman. Z and Ahmad. A.L. Coagulation–flocculation process for POME treatment using Moringa Oleifera seeds extract: Optimization studies. Chemical Engineering Journal, 133, 205-212,* ***2007a.***

ix. *Ghebremichael. K. A, Gunaratna. K. R and Dalhammar. G. Single-step ion exchange purification of the coagulant protein from Moringa Oleifera seed. Journal of Applied Microbial Biotechnology, 70, 526–532,* ***2006.***

x. *Kalavathy. M.H and Miranda.L.M. Moringa Oleifera—A solid phase extractant for the removal of copper, nickel and zinc from aqueous solutions. Chemical Engineering Journal,* ***2009.***

xi. *Lea. M. Bioremediation of Turbid Surface Water Using Seed Extract from Moringa Oleifera Lam (Drumstick) Tree. Current Protocols in Microbiology, 2.1 – 2.4,* ***2010.***